

vessels in widely scattered positions encountered heavy weather. Storm log:

British S. S. *Araguaya*:

Gale began on the 22d, wind WSW., 7. Lowest barometer 29.76 inches at 7 a. m. on the 22d, wind WSW., 7, in latitude $37^{\circ} 26' N.$, longitude $69^{\circ} 48' W.$ End on the 23d, wind SW., 7. Highest force of wind 8, SW.; wind WSW. to SW. throughout.

The western disturbance remained nearly stationary until the 27th, when it began to move slowly eastward, and on the 28th the center was apparently a short distance east of St. Johns, Newfoundland; it was comparatively slight in intensity, and the only gales reported were on the 24th and 25th from a restricted area between the Bermudas and Nantucket, and on the 27th in the region between the 35th and 40th parallels and 45th and 50th meridians. Storm log:

American S. S. *Abron*:

Gale began on the 24th, wind NW. Lowest barometer 29.53 inches at 8 a. m. on the 25th, wind NW., 7, in latitude $38^{\circ} N.$, longitude $67^{\circ} W.$ End on the 26th, wind N. Highest force of wind 8, NW.; steady NW.

On the 25th and 26th a well-developed area of low pressure covered the greater part of the North Sea, and winds of gale force were recorded at the land stations at Lerwick, Shetland Islands, and also at Portland Bill on the south coast of England. Storm log:

British S. S. *Finchley*:

Gale began on the 24th, wind S. Lowest barometer 29.25 inches at 5 p. m. on the 25th, wind W., 8, in latitude $37^{\circ} N.$, longitude $9^{\circ} W.$ End on the 26th, wind NNE. Highest force of wind 8; shifts W.-NNE.

On the 29th there appeared a vigorous disturbance off the American coast, between New York and Charleston, that moved northeastward, and on the 30th was central between Portland and Eastport, Maine. The storm area was of limited extent, but vessels west of the 60th meridian experienced strong southerly to westerly gales. Storm log:

American S. S. *Chester Sun*:

Gale began on the 28th, wind S. Lowest barometer 29.42 inches at 9:35 p. m. on the 29th, wind SSW., in latitude $35^{\circ} 48' N.$, longitude $75^{\circ} 19' W.$ End on the 29th, wind NNW. Highest force of wind 11; shifts SSW.-NNW.

On the 29th and 30th moderate gales were also reported by a few vessels in the eastern section of the steamer lanes. Storm logs:

British S. S. *Norfolk Range*:

Gale began on the 29th, wind NE., 7. Lowest barometer 29.58 inches at 7 a. m. on the 29th, wind NE., 7, in latitude $54^{\circ} 40' N.$, longitude $26^{\circ} 47' W.$ End on the 30th wind NNE., 6. Highest force of wind 9; shifts NE.-NNE.

British S. S. *Comanche*:

Gale began on the 29th, wind WSW. Lowest barometer 29.44 inches at 10 a. m. on the 30th, wind WSW., 7, in latitude $52^{\circ} 46' N.$, longitude $16^{\circ} 52' W.$ End on May 1, wind NW. Highest force of wind 8; shifts WSW.-N.-NW.

NORTH PACIFIC OCEAN.

By WILLIS E. HURD.

There was much fine weather over the North Pacific Ocean during April, although the fluctuating cyclonic activity over the northern area seemed to be much more pronounced and the conditions more unsettled than during March. Indeed, the wind on the 1st, 2d, and 12th attained a higher force, 11 to 12, than was reported for the preceding month. On the 1st and 2d, also, the lowest pressures of the two months occurred.

In the Hawaiian area the wind movement at Honolulu was somewhat higher than the average, being 10.7 miles per hour as compared with the 19-year average of 9.1 miles. The highest velocity was 30 miles from the east

on the 29th, and the prevailing direction was east. For the greater part of April Honolulu lay on the southwestern slope of the North Pacific high. On the 24th to 26th it lay within a depression which finally disappeared without having taken on apparent progressive movement. That the depression developed some slight intensity, however, is evidenced by an observation of the American S. S. *President Pierce*, in latitude $25^{\circ} 10' N.$, longitude $166^{\circ} 30' W.$, on the 25th, when a gale of force 8 from the north-northwest was observed, pressure 29.78 inches. The gale on the 29th at Honolulu was due to the rather steep gradient on the southern slope of the high-pressure area, which at this time had shifted to the north of Hawaii.

In the tropical storm regions no cyclonic activity of moment seems to have occurred, and only a few scattered gales disturbed the general serenity. On the 19th the northeast monsoon was reported of gale force, accompanied by rain and fog, near the lower entrance to the Formosa Channel; and on the same and other dates, at the opposite extreme of the ocean, the Gulf of Tehuantepec was swept by intermittent northerly to westerly gales.

Off the Mexican and Central American coasts light northwesterly winds were of frequent occurrence, but interspersed with variable breezes. In the main the weather experienced by the American S. S. *Venezuela* from the 12th to the 26th, while steaming up the coast from Panama toward San Pedro, is descriptive of the typical spring conditions in these waters. Captain W. J. Allen thus commented:

In April on the west coast of Central America it was observed the winds were very variable—no land nor sea breezes prevailing—light breezes from any quadrant and frequent calms. Clear and cloudy, frequently overcast and very hazy at night, with threatening rain, but no heavy showers.

Respecting the traveling storms of this month, several crossed Japan, coming from the Asiatic continent. Pressure was low over this area on the 4th and 5th, 7th to 12th, 18th and 19th, and 27th to 29th. Dangerous gales occurred over the Japan Sea on the 12th, particularly. The Canadian S. S. *Canadian Prospector* reported a "fierce storm," with violent squalls of hurricane force, overcast and misty, wind NW. to N., in latitude $37^{\circ} 41' N.$, longitude $134^{\circ} 04' E.$, lowest pressure 28.86 inches. Westerly gales of force 8 to 10 were reported by several vessels immediately to the eastward of Japan on this date.

Among the storms, or lows, that entered the American continent, nearly all were offshoots from the prevailing cyclonic areas to the westward, rather than eastward-moving storms in their entirety. These secondary developments entered the coast at some point between Oregon and Alaska on the 2d, 6th, 15th, 16th, 20th, 24th, and 30th.

The severe disturbance of the 1st to 2d of April, of which mention was made in the report on the weather of March, developed hurricane violence. It was central on the 1st in about $48^{\circ} N.$, $177^{\circ} E.$, and on the 2d in approximately $50^{\circ} N.$, $166^{\circ} W.$ On the 2d another violent cyclone was central near $48^{\circ} N.$, $160^{\circ} E.$, and on the 3d near $48^{\circ} N.$, $170^{\circ} E.$ Both storm centers filled up considerably on the 4th. The lowest pressure observed in connection with these disturbances was 28.20 inches, reported by the Japanese S. S. *Kaga Maru* as occurring early on the morning of the 2d, in latitude $50^{\circ} N.$, longitude $176^{\circ} 30' E.$ The minimum reading on the 1st was 28.24 inches, as noted in the preceding report. The *Kaga Maru*, steaming toward Yokohama,

had scarcely emerged from the first storm area than she entered the second, and again experienced westerly winds of storm force, though of somewhat less violence.

On the 5th a small storm of some intensity appeared off the coast of Washington, at which time the Weather Bureau station at North Head reported a maximum wind velocity of 65 miles from the south, lowest pressure 29.58 inches, on the 6th.

Gales of force 7 to 10 were observed in middle latitudes and longitudes on the 6th to 8th and 11th to 14th, lowest pressure, 29.16 inches, on the 13th. On the 14th and 15th, in connection with a strong LOW then covering the Gulf of Alaska and adjacent waters to the southward, several vessels reported gales of force up to 10 and pressures below 29.00 inches. The Japanese S. S. *Shidzuoka Maru* experienced the lowest pressure, 28.63 inches, with a northwest gale, in latitude $49^{\circ} 24' N.$, longitude $145^{\circ} 44' W.$, on the 14th; and the American S. S. *Dellwood* on the same date encountered an east gale, force 10, in $58^{\circ} 10' N.$, $136^{\circ} 39' W.$ On the 15th the *Dellwood* reported a barometer "down to 28.90 inches (uncorrected) for six hours," with wind still high during the morning hours, while in and near latitude $59^{\circ} 08' N.$, longitude $141^{\circ} 35' W.$

On the 22d to 24th the British S. S. *Empress of Asia* passed through one storm central near the Peninsula of Alaska, and entered another over the western Aleutians. On the 22d, in approximately latitude $52^{\circ} N.$, longitude $154^{\circ} W.$, she experienced a wind from the south, force 10, pressure 29.18 inches; on the 23d, in $52^{\circ} N.$, $164^{\circ} W.$, she observed a northwest wind, force 10, pressure 29.56 inches; and on the 24th, in $51^{\circ} N.$, $176^{\circ} W.$, a southwest wind, force 8, pressure 29.64 inches. These storms were of the Aleutian LOW type.

Among the few gales thus far reported for the period April 25 to 30, the American S. S. *Stockton* experienced one from the west, force 8, in $46^{\circ} 41' N.$, $169^{\circ} 06' W.$, pressure 29.97 inches, on the 29th. On the same date the Japanese S. S. *Yokohama Maru* encountered a west-northwesterly gale, force 8, lowest pressure 29.42 inches, in $50^{\circ} 14' N.$, $139^{\circ} 04' W.$ On the 30th North Head recorded a maximum wind velocity of 58 miles from the south, in connection with a storm area central to the westward of British Columbia.

On the 26th of April Observer Dumaresq, of the American S. S. *Atlanta City*, San Pedro toward Yoko-

hama, the wind being light at the time, witnessed a peculiar condition which he thus describes:

The sharpest shift of wind and sea I have ever seen occurred April 26, at 4 p. m. in latitude $34^{\circ} 19' N.$, longitude $150^{\circ} 20' E.$ Wind and sea had been SW. all day, and as suddenly as though a fan had been turned both wind and sea shifted to NW. We could plainly see a narrow stretch of confused sea where the two met.

During the greater part of the month the series of low-pressure areas which dominated the weather over the Aleutian region and over a wide stretch of ocean from the Peninsula of Alaska southeastward, were more energetic even than during March. In general they formed two centers of activity, one of which may be placed nearly over Dutch Harbor on the west and the other over the northern portion of the Gulf of Alaska on the east.

The North Pacific high-pressure area, normally central to the northeast of Hawaii, was generally well developed after the 10th of the month. Prior to that it was distorted and shallow, with low-pressure areas occupying a portion of its normal area on the northeast or northwest. At the close of the month its center had moved to the westward and northward, with a crest of 30.50 inches near latitude $40^{\circ} N.$, longitude $155^{\circ} W.$

Pressure was below normal over the eastern part of the ocean, as shown by observations at the island stations. In this respect conditions were similar to those of the preceding month. In April, however, the greatest relative deficiency was at Dutch Harbor (-0.28 inch), whereas in March it was at Honolulu (0.07 inch). The average pressure at Dutch Harbor, based on p. m. reports, was 29.57 inches. The highest pressure, 30.16 inches occurred on the 25th; the lowest, 28.82 inches, on the 8th. Absolute range, 1.34 inches. At Honolulu the mean p. m. pressure was 30.02 inches, or 0.04 inch below normal. The highest pressure, 30.15 inches, occurred on the 12th; the lowest, 29.79, on the 25th. At Midway Island the mean p. m. pressure was 30.11 inches, or 0.02 inch below normal. The highest pressure, 30.28 inches, occurred on the 28th; the lowest, 29.88, on the 29th and 30th.

Fog was observed almost daily over the northern and central routes both east and west of the 180th meridian, but was of particularly frequent occurrence after the middle of the month. It was noted on the China coast on several days as far south as Swatow and Hongkong.

DETAILS OF THE WEATHER IN THE UNITED STATES.

GENERAL CONDITIONS.

ALFRED J. HENRY.

Aside from the variability characteristic of a transition month, the weather of April, 1923, presented no distinctive features of consequence.

Many secondary cyclonic systems had their origin over the southern Plateau and Rocky Mountain region, and when such is the case the anticyclones almost invariably appear in Canadian Provinces and move east-southeast as was the case in the current month—see Charts I and II. The usual details follow.

CYCLONES AND ANTICYCLONES.

By W. P. DAY.

Fifteen low-pressure areas developed over the south and southwest or entered the country on the Pacific coast. This is an unusual number for the season of the year and

would be rather excessive even for a winter month. However, the dampening effect on the movements of the cyclones and anticyclones, which is a normal occurrence in April, was quite noticeable before the end of the month. This slowing up, and in some cases reversal of the general circulation, is due to the change in pressure distribution over land and water areas. This change is slow and masked by the passing cyclones and anticyclones; but as the continents rapidly warm, we see them change from areas covered normally by high pressure to areas of indifferent or low pressure, and at the same time the pressure is rising over the relatively colder water areas.

FREE-AIR SUMMARY.

By L. T. SAMUELS, Meteorologist.

Free-air conditions for the month averaged in most cases close to their normal values. (See Table 1.) Negative temperature departures obtained at nearly all levels at Broken Arrow, Due West, and Royal Center,